MAPFINDER

search

About the Products

The products below can be accessed through the MapFinder search engine. Click on the product name or icon for a complete description of the product. Click on FGDC Metadata to download the metadata as a portable format document (pdf). These files can be viewed with Adobe Acrobat Reader. Adobe Acrobat Reader can be downloaded for free from the site.

Hydrographic Survey Outlines

Hydrographic surveys, the earliest of which date to 1837, determine the configuration of the bottoms and tidal depths of water bodies. Modern surveys include the detection, location, and identification of wrecks and obstructions, primarily through the use of sidescan sonar and multibeam sonar technology. The primary product of a hydrographic survey is a map called a Smooth Sheet, on which is plotted relevant shorelines (from coastal surveys) and water depths corrected to an appropriate tidal datum (usually mean low water).

The NOS MapFinder spatial inventory contains the entire record of thousands of surveys going back to the early 1800s. These surveys are presented as color-coded, searchable maps that allow users to quickly assess the availability and currency of depth data for any area of the country. FGDC Metadata (pdf, 116 kb)

About the Products

Hydrographic Survey

Estuarine Bathymetry

Coastal Photography

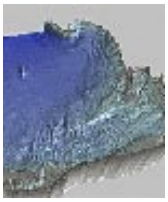
Environmental Sensitivity Index (ESI) Maps

Nautical Charts

Coastal Survey Maps

Water Level Stations

Geodetic Control Points



Estuarine Bathymetry

The National Ocean Service's (NOS) Estuarine Bathymetry is a digital raster compilation of NOS' hydrographic survey data for selected U.S. estuaries. These data provide an important piece of the mapping puzzle to those managing our Nation's valuable estuarine resources. Although bathymetric data are most commonly used to create nautical charts, they are a crucial component in many fields of marine research, and a useful enhancement for 2D and 3D mapping.

The 70 estuarine bathymetry data sets accessible from MapFinder are available in both 30 meter and 3 arc second resolutions. The gridded bathymetry are an interpolated data set representing the most up-to-date depth sounding information that was available at the time of publication (1998). In a few cases the most up-to-date information was surveyed more than a century ago. FGDC Metadata (pdf, 124 kb)

Coastal photography

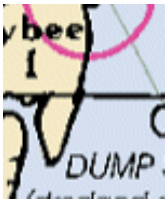
Since about 1940, precision aerial photography has been used as source material for coastal survey maps. The NOS photographic library now contains in excess of 500,000 film images. The coverage area includes portions of the coastal regions of the United States and its possessions, including the Great Lakes and their connecting navigable waterways.

NOS MapFinder contains an index of more than 60,000 aerial photographs taken since 1990. Around 15,000 of those images are currently viewable and available on line (100 dpi, full color). The spatial inventory for this theme shows the footprint of each image. FGDC Metadata (pdf, 104 kb)

Environmental Sensitivity Index (ESI) maps

ESI maps are an integral component of oil spill contingency planning, and serve as the first source of information in the event of an incident. They contain three general types of information: shoreline classification (with regard to sensitivity to oil fouling), human-use resources, and biological resources. This information is plotted on USGS 7.5-minute quadrangle maps.

NOS MapFinder provides an inventory and GIF images of all ESI maps available for download. The current coverage includes the majority of the coastal U.S. (including Alaska and Hawaii) as well as Puerto Rico and the Virgin Islands. FGDC Metadata (pdf, 112 kb)



Nautical Charts

The nautical chart is the most fundamental of navigational tools required for safe passage of waterborne commerce. These maps show the location of the shoreline, minimum water depths, aids to navigation, hazards to navigation and much more. Official digital copies are commercially available from MapTech, NOS' business partner.

NOS MapFinder provides a Nautical Chart inventory for over 2,000 charts and chart insets.

Coastal survey maps

In 1807, President Thomas Jefferson created The Survey of the Coast to chart the U.S. coast and its harbors. One of the products of this still-evolving survey are topographic maps (commonly referred to as T-sheets) that delineate the shoreline and identify other features, such as rocks and tidal flats, which are important for marine navigation and commerce. These maps are a prime source of spatial data in coastal regions, and are often used in legal proceedings. Typically, they cover a coastal region of about 40 square miles.

NOS MapFinder contains an index of 3,000 Coastal Survey Maps, and the corresponding raster GIF images (100 dpi) for the entire Atlantic, Pacific, and Gulf coasts, and portions of the Great Lakes, Alaska, Hawaii, and Puerto Rico. FGDC Metadata

(pdf, 108 kb)

Water- Level Stations

Water-level data are gathered to provide accurate predictions of tide stages. The data are collected at hundreds of continuous stations located around the U.S. coast including the Great Lakes.

NOS MapFinder offers an inventory to these stations, a link to real-time data, and a descriptive sheet providing a summary of the type of data gathered at each station. FGDC Metadata (pdf, 120 kb)

Geodetic Control Points

The Nation's geodetic network provides data required for absolute horizontal and vertical positioning, which creates consistency among individual spatial surveys and maps. It has been established, and is maintained as, a high-accuracy, four-dimensional network of monumented stations at 1° x 1° (75 km to 125 km) nominal spacing throughout the U.S. and its territories.

NOS MapFinder locates the most important of these points and offers the official data sheet for each describing its specific location and precision reference data. FGDC Metadata (pdf, 124 kb)

(top)

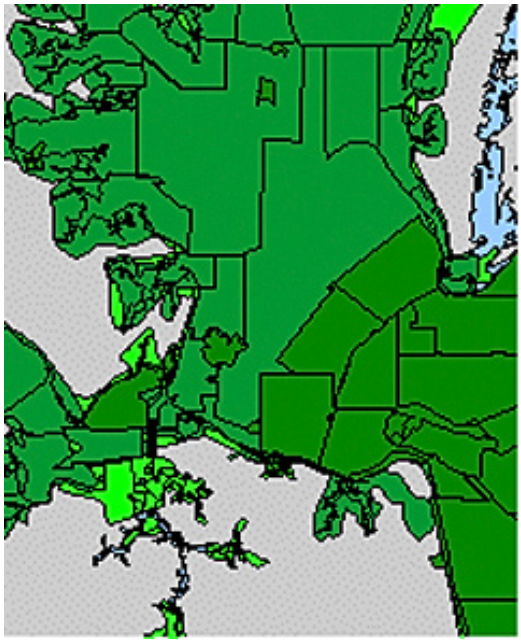
MAPFINDER

Hydrographic Survey Outlines

Abstract | Description | History | Present Status

Abstract

Hydrographic surveys measure and define the configuration of the bottoms and adjacent land areas of water bodies, especially as they pertain to navigation. This information is critically important to the production of nautical charts and is also useful to the fishing industry and coastal zone managers. They are the primary responsibility of the Coast Survey's Hydrographic Surveys Division.



Hydrographic survey outlines, here shown at the entrance to Chesapeake Bay, measure and define the configuration of the bottoms and adjacent land areas of water bodies, especially as they pertain to navigation.

The primary product of a hydrographic survey is a smooth sheet. The smooth sheet depicts corrected depths relative to an appropriate vertical datum (usually a water level datum) along with relevant shoreline derived from a variety of remote sensing techniques. Smooth sheets also depict hazards to navigation (rocks, wrecks, obstructions, etc.), shoal developments, channel delineations, aids to navigation and landmarks. Digital survey data, collected since the mid-1930's, has been archived and is available from NOAA's National Geophysical Data Center on CD-ROM.

The NOS MapFinder provides a geo-spatial index of over 10,000 hydrographic and field exam surveys covering the continental U.S. and territories that span from 1837 to the present. Users can locate the limits of individual surveys and retrieve additional survey specific information. Surveys are mapped so that the most recent

search

For More Information

FGDC Metadata (pdf, 104 kb)

Office of Coast Survey Hydrographic Surveys

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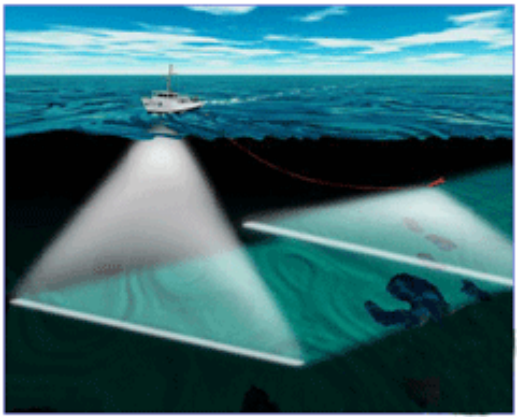
appear "on top" as illustrated in the example on this page.

Further information on hydrographic surveys, digital data products, and other programs of the Coast Survey, can be found at the Coast Survey Home Page.

Description



Hull-mounted multibeam sonar (left) and towed side scan sonar (right) are used for the detection, location, and identification of wrecks and obstructions.

The principle objective of hydrographic surveys is to obtain basic data for the compilation of nautical charts with emphasis on features that may affect safe navigation. In addition to measuring water depths, surveys identify hazards to navigation, delineate channels, and verify aids to navigation and landmarks. Each survey represents a comprehensive record of the coastline and adjacent waters. A record of changes caused by natural processes and human activities can be compiled from a review of contemporary and prior surveys of the same area. Presently there are over 10,600 hydrographic surveys contained in the archive. Of this total, approximately 4900 surveys spanning from 1851 to the present are in digital form.

History

In 1807, Thomas Jefferson created the Survey of the Coast "...to cause a survey to be taken of coasts of the United States, in which shall be designated the islands and shoals and places of anchorage..." The first Superintendent of the new bureau was a Swiss mathematician and geodesist, Ferdinand Hassler. His fundamental plan was to divide the operations into three great branches - the geodetic, the topographic, and the hydrographic.

The first topographic and hydrographic surveys were completed in 1834 and covered the area of Great South Bay, Long Island. Early hydrographic surveys consisted of depths measured by sounding pole and hand lead line with positions determined by three-point sextant fixes to mapped reference points. Efficiency and accuracy was improved with the development of echo sounders which became available in the early 1930's and electronic navigation systems developed during the 1940's.

Today, survey data is collected by computer supported hydrographic data acquisition systems having multiple sounding sensors and GPS navigation. Prior to a hydrographic survey, aerial photography

produces a coastal survey map depicting the shoreline and its features. Other preparation procedures include a comprehensive collection of historical surveys, wreck and obstruction reports, coastal survey maps, and vertical and horizontal datum information.

Early hydrographic surveys consisted of depths measured by sounding pole and hand lead line with positions determined by three-point sextant fixes to mapped reference points.

Raw soundings are digitally collected at various water level stages. These soundings are then adjusted to a standard or absolute surface (vertical datum) using predicted water level correctors derived from analyzed tidal characteristics at historical measurements at long-term, primary sites. Where available, the preliminary soundings are initially adjusted using preliminary observed data from active, near real-time water level stations. In addition, short-term water level monitoring stations may be installed in the immediate survey area to measure relative water levels more accurately. Horizontal positions are recorded using Differential GPS and need no further adjustment. The coast line is compared extensively to recent coastal survey maps to identify new features and modifications to the survey maps.

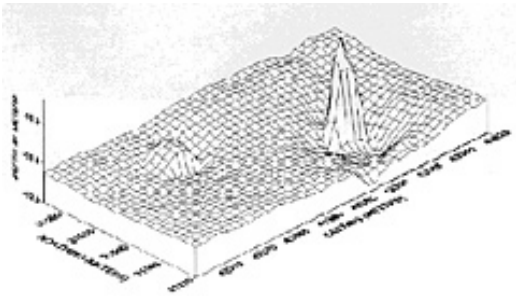
Eventually, the sounding data are re-processed using appropriate final vertical datum corrections (i.e., verified observed water levels relative to Mean Lower Low Water) to produce the final soundings. GPS techniques are currently being immplemented for potential increases in efficinecy and accuracy of vertical control. The final soundings are compiled with a digital representation of the shoreline to produce a "smooth sheet." The smooth sheet is then made available for use in the compilation of nautical charts. Corresponding digital data is generated and archived at National Geophysical Data Center (NGDC).

Present Status

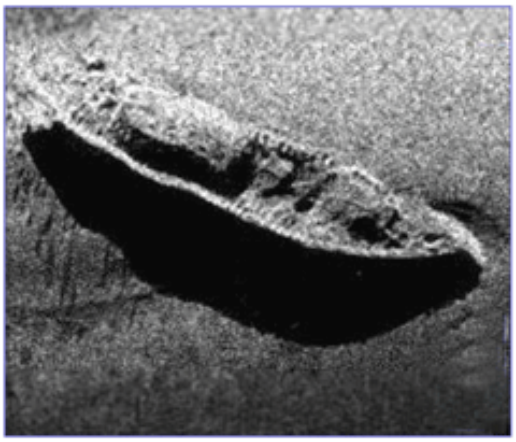
NOS field parties and outside contractors complete approximately 40 to 50 hydrographic surveys each year. To collect up-to-date hydrographic survey data and to satisfy the maritime constituency, the Coast Survey has developed a survey priority plan to identify those areas with the highest risk of serious maritime accidents. This risk assessment is based on a combination of traffic volume, inadequacy of charts or surveys, and potentially insufficient underkeel clearance.

More modern technologies have been recently implemented to increase the quality and productivity of new surveys. This includes

the detection, location, and identification of wrecks and obstructions primarily through the use of side scan sonar and multibeam sonar technology.



Gridded multibeam sonar depths in the approaches to New York Harbor. Multibeam sonar systems provide coverage of the seafloor similar to side scan sonars, but data is in digital form rather than images.



Side scan sonar image of the USS Monitor on the ocean floor. Objects that protrude from the bottom create a dark image (strong return) and shadows from these objects are light areas (little or no return).

The strength of the return echo is continuously recorded creating a "picture" of the ocean bottom where objects that protrude from the bottom create a dark image (strong return) and shadows from these objects are light areas (little or no return). Multibeam sonar systems provide coverage of the seafloor similar to side scan sonars, but data is in digital form rather than images. The NOAA Ship RUDE used both of these systems in surveying the TWA Flight 800 crash site south of Moriches Bay, New York.

(top)

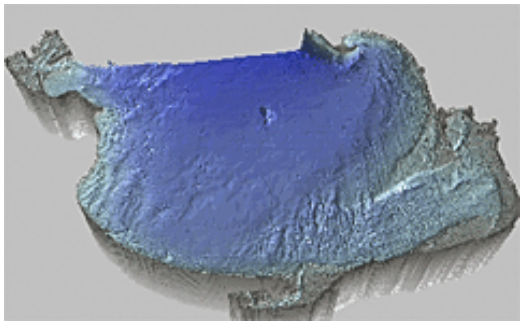
MAPFINDER

Estuarine Bathymetry

Abstract | Description | History | Present Status

Abstract

The National Ocean Service's (NOS) Estuarine Bathymetry is a digital raster compilation of NOS' hydrographic survey data for selected U.S. estuaries. These data provide an important piece of the mapping puzzle to those managing our Nation's valuable estuarine resources. Although bathymetric data are most commonly used to create nautical charts, they are a crucial component in many fields of marine research, and a useful enhancement for 2D and 3D mapping.



Thirty meter digital bathymetry of Cape Cod Bay, Massachusetts.

The 71 estuarine bathymetry data sets accessible from MapFinder are available in both 30 meter and 3 arc second resolutions. The gridded bathymetry are an interpolated data set representing the most up-to-date depth sounding information that was available at the time of publication (1998). In a few cases the most up-to-date information was surveyed more than a century ago. Although the original data are the same source data used to create nautical charts, these data sets should not be used for navigation.

In addition to the data itself, a number of supporting files are also included within the compressed download files. These files are intended to help the user understand the possible uses of the data, and how the data sets were created. Many of the estuaries included in MapFinder cover large geographic areas. The resulting file sizes for some of these estuaries are very large. To speed downloading, the files have been compressed to approximately one tenth their original size, and put into archive files for each estuary. Refer to the Bathymetry File Size Chart for specific file sizes.

Description

search

For More Information

FGDC Metadata (pdf, 124 kb)

Special Projects Office Estuarine Bathymetry

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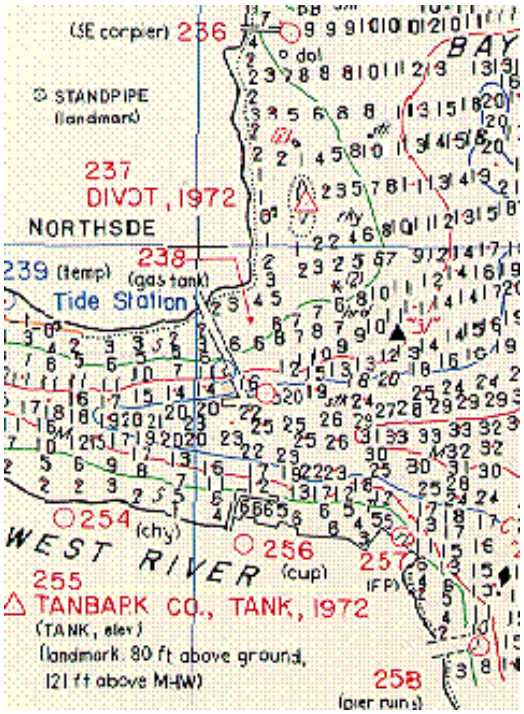
Estuarine Bathymetry was developed by the Special Projects Office of the National Ocean Service (NOS) as part of a project to produce readily available bathymetry. Seventy-one of the approximately 130 estuaries within the conterminous U.S. are available from this site. Those estuaries which are not included, were those that had less than 80% coverage of digital sounding data needed to support detailed bathymetric processing.

Bathymetric data are best known as navigational tools. However, on its own, or in conjunction with other geographic data, bathymetric data adds another dimension to geographic mapping and modeling and can be used either as a background layer or as a 3D surface for draping thematic maps such as benthic habitats, marine organism habitats or geologic data. Bathymetric data are a critical component for hydrodynamic models and serve as the lower boundary of the water column for computing water circulation and movement. These models are necessary to understand or predict movement of oil and hazardous materials, temperature and salinity distributions, migration of animals, and modeling storm surge and tsunami effects, to name a few.

The bathymetry data sets offered through MapFinder are a digital gridded depth data product offered in the Digital Elevation Model (DEM) format in both 30 meter, and 3 arc second resolutions, derived from source soundings collected by NOS Hydrographic Surveys Division. The extent of the bathymetry data for each estuary are defined by the water boundary component of the NOS Coastal Assessment Framework's, Estuarine Drainage Area. Elevations do not extend beyond the high water line.



Portion of a hydrographic survey, a sampling of points representing depth values for specific locations.

Source hydrographic surveys are soundings collected by NOS over the last 150 years, (these data are housed in the national archives of the National Geophysical Data Center, Boulder, CO). Bathymetric elevations are referenced to the local tidal datum, typically Mean Lowest Low Water (MLLW) averaged over a 19 year tidal epoch.

In addition to the bathymetric DEM data found on this site, supporting information is also included with each compressed file. These include views depicting the coverage of the original and

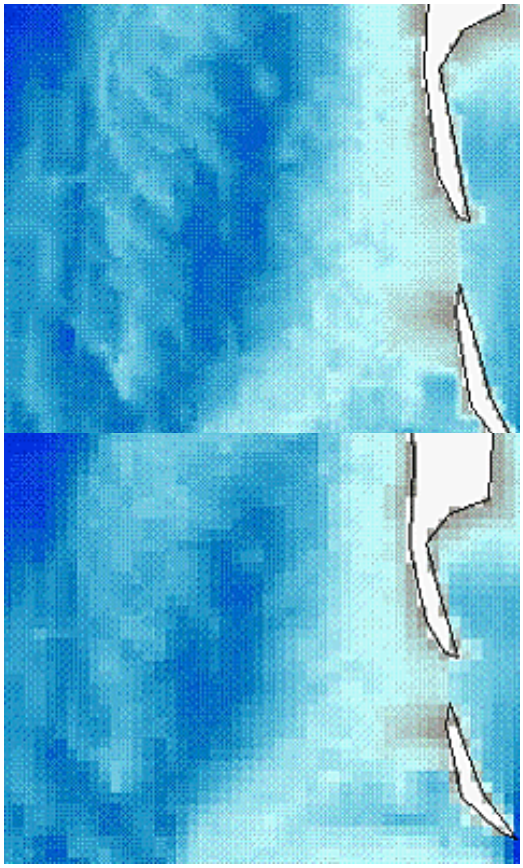
interpolated soundings, graphical indexes which show the outlines of the DEM files contained in the compressed file sets, information on the content and use of the files, and metadata.

History

The source depth soundings for this project were obtained from the Hydrographic Surveys Division of NOS. These surveys represent data collected from the 1840's to present day. The principle objective of hydrographic surveys is to obtain basic data for the compilation of nautical charts with emphasis on features that may effect safe navigation. Nautical charts include information beyond depth soundings, such as rocks, hazards, and maintained channels, and are updated regularly. Although the bathymetric data offered on this site are derived from the same original data sets as NOAA's Nautical Charts, these data have not been put through the same selection process that the nautical charting requires***. Therefore, this data should not be used for navigation.*** Please see the Hydrographic Surveys product page, for more information on the source data.

Because the source data are simply a sampling of points representing depth values for specific locations, the raw data are not immediately useful without interpolation. The estuarine bathymetry was derived using a Triangulated Irregular Network (TIN) interpolation process. Original data were combined with shoreline data points attributed with mean high water elevations. These composite data files were interpolated using a linear TIN process.

A filter of 30 meters was applied to the resulting TIN file to find the closest data values to the center of the each of the 30 meter cells. The resulting files are 30 meter digital grids, UTM projected units containing position, and depth information for each grid cell.



A second grid filter of 3 arc seconds per grid was then applied to the 30 meter grid file to find average data values within each of the 3 arc second grids. Center point values from the 3 arc second grids were exported, re-combined with shoreline data points, projected to a Geographic coordinate system, and re-triangulated to create the 3 arc second DEM file. 3 arc second grids are rectangular and vary in size

depending on latitude. In Florida, for example, 3 arc second grids are approximately 90m(h) x 81m (w), while in Maine they are approximately 90m(h) x 71m (w).

Comparison of resolution of a small portion of Cape Cod estuary. Above: 30 meter bathymetry (1"=1200 meters). Below: 3 arc second bathymetry (1"=1200 meters)

These files were then converted to DEM format and split into 7.5 minute (for 30m DEMs) or 1 degree (for 3 arc second DEMs) sections. For those interested in large portions of estuaries, or entire estuaries, "BIG", non standard, DEMs for each resolution are also provided. These "Big" DEM's contain all the information in one tile where extents are that of the estuary. It should be noted that these files, when uncompressed, can be more than 100Mb in size. For a more complete description of the data, see the metadata files (pdf, 124 kb) for Estuarine Bathymetry.

Present Status

At this time, the Special Projects Office does not plan to produce any additional estuarine bathymetry. However, in the event that other organizations make data available, which meet the processing criteria set for this project, every effort will be made to provide public access.

(top)

MAPFINDER

Coastal Aerial Photography

Abstract | Description | History | Present Status

Abstract

Since the late 1930's, precision aerial photography, a responsibility of NOS' National Geodetic Survey Remote Sensing Division, has been the primary source material for coastal survey maps. Georeferenced, high resolution photographs are used to delineate the shoreline and shoreline features. These photographs have many other uses such as coastal management, waterfront development, and natural resource identification.

Georeferenced, high resolution aerial photographs are used to delineate the shoreline and shoreline features.

The primary aerial photographic product is a 9x9 inch color photograph usually exposed at scales from 1:10,000 to 1:50,000. Presently there are over 500,000 such photo negatives in the NOS archives dating from 1945 to the present year.

The NOS MapFinder contains an index of more than 60,000 aerial photographs taken since 1990. Around 15,000 of those images are currently viewable and available on line (100 dpi, full color).

Further information on aerial photography and other programs of the National Geodetic Survey (NGS), can be found at the NGS Home Page.

Description

Aerial photography has been used to create accurate maps of the Nation's coastline since the late 1930's and became the sole source for coastal mapping in 1980. This valuable resource of

search

For More Information

FGDC Metadata (pdf, 104 kb)

National Geodetic Survey Remote Sensing Division

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approximately a half million coastal photographs has many uses including: coastal management, waterfront development, natural resource identification, coastal change analysis, habitat identification, and recreational planning.

The photographs, which are shot and maintained by NOAA's National Geodetic Survey (NGS), are used for a variety of geo-positioning applications, which include delineating the shoreline for Nautical Chart creation, measuring water depths (photobathymetry), topographic mapping, mapping seabed characteristics, and locating features or obstructions to ensure the safety of marine and air navigation.

Aerial photo of Coos Bay, Oregon, in standard 9x9 inch format.

NGS' area of photogrammetric responsibility includes all coastal regions of the United States and its possessions, including the Great Lakes and their connecting navigable waterways. This represents approximately 95,000 miles of shoreline. Aerial photography surveys are flown on varying time cycles depending on the amount of change caused by anthropomorphic or natural forces.

The primary aerial photographic product is a 9x9 inch color photograph which is usually exposed at scales from 1:10,000 to 1:50,000, varying slightly due to such factors as shrinkage or expansion of the paper caused by atmospheric conditions, accuracy of reported flight altitude, tip and tilt of the aircraft, and the effect of ground relief. Types of imagery include natural color, panchromatic, false-color infrared, and black-and-white (B&W) infrared photography. Photographic prints from about 1945 to the present are currently available from NGS.

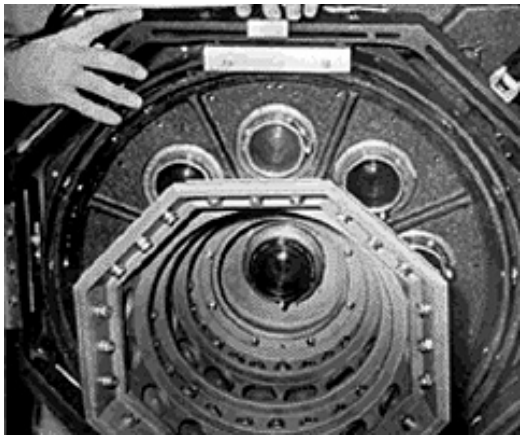
History

In 1807, Thomas Jefferson created the Survey of the Coast "...to cause a survey to be taken of coasts of the United States, in which shall be designated the islands and shoals and places of anchorage..." The first Superintendent of the new bureau was a Swiss mathematician and geodesist, Ferdinand Hassler. His fundamental plan was to divide the operations into three branches - the geodetic, the topographic, and the hydrographic.

Since then, the primary mission of the National Ocean Service (NOS) and its predecessor agencies has been to accurately survey the coast of the United States. For more than 50 years, aerial photography has been the primary source of information used to

meet this mandate.

Beginning in 1936, photographic surveys began to replace plane table field surveys because they could be completed faster and less expensively. In 1936, the Agency developed the nine-lens camera, constructed with nine parallel lenses that simultaneously exposed images on one frame of film. This camera system was used until 1961.



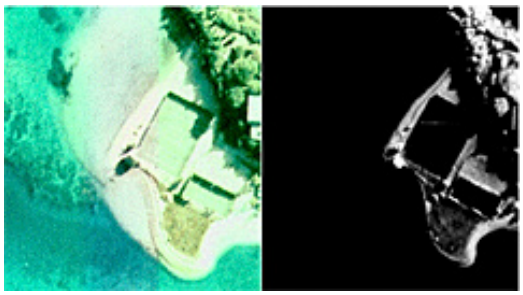
The nine-lens camera system, constructed with nine parallel lenses that simultaneously exposed images on one frame of film, was used until 1961.

In 1944, the agency also began to use commercial single lens cameras having a 9 inch by 9 inch format. This type of format camera is still used today. Since 1945, aerial photographs have been used almost exclusively to survey the shoreline and locate topographic data for nautical charting. To this end, the Agency has developed and refined techniques for precisely delineating the shoreline from aerial photographs using analytical stereo photogrammetry.

The accurate location of the shoreline is extremely important because it is the boundary that defines private, state, and federal ownership. In areas where an adequate water level datum has been established, photogrammetry is most often the best methodology for delineating the mean lower low water (MLLW) and mean high water (MHW) lines. B&W infrared photography provides a sharp contrast between water and land especially along gentle sloping shore areas. NOS has used infrared emulsion film for about 50 years. In tidal waters, infrared photography is tide-coordinated and exposed at specific water levels, generally at the MHW and MLLW water datums. These datum lines are used to define marine boundaries such the MLLW datum line which is the baseline for determining the 3- and 12-mile territorial sea limits.

NOS was the first agency in the world to use color aerial film in the production of maps. Beginning in 1945, the Bureau experimented with and assisted industry in the development of color emulsions and stable film bases suitable for use as color aerial film. Because of the improvements made to color aerial film, natural color photography is no longer considered as merely an interpretative aid to panchromatic photography. Modern color imagery, with its excellent clear water penetration characteristics and dramatic presentation of submerged detail, provides a basic alternative tool and supplement to classic hydrographic methods for mapping the sea bed in shoals and waters of moderate depth. Color photographs can clearly separate details not recorded on panchromatic film.

Over the years, the image resolution capabilities and spectral quality of aerial films have continually advanced, and so have camera systems, photogrammetric instruments, and processes. For example, the ground resolution (unit detection size) of modern color aerial photography at a nominal scale of 1:48,000 is approximately 1-meter and well-defined features can be located within 3 meters of their true position.



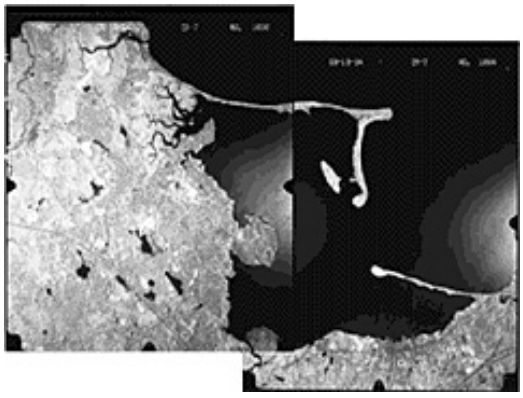
Comparison of the same shoreline using black and white infrared and color photography. Black and white is used to delineate precise shoreline, and color is used for below water features.

Until the early 1990s, NGS georeferenced photography using surveyed markers or reference points on the ground. The advent of GPS technology during the late 1980s gave rise to development of airborne GPS capabilities to complement photographic surveys. By 1992, GPS technology was fully deployed to determine highly accurate camera positions for all photographs. This new technology reduced the amount of ground survey points required for the photogrammetric processes. Since 1992, all photography has been acquired with GPS georeferencing.

Present Status

NGS maintains a library of all aerial photographic film associated with surveys of the coast dating back to 1945. There are over 500,000 coastal photographs in the library, and about 15,000 new photographs are acquired every year. These photographs are of metric quality for mapping purposes; they overlap 60% along a strip, which allows coverage to be viewed in stereo and precise photogrammetric measurements to be made in order to locate features accurately.

Photographic scales and photography cycles vary depending on the survey requirements and the amount of change caused by cultural or natural forces. Over one-third of the U.S. shoreline area has never been surveyed by photogrammetric methods. New and recurring photographic missions of the coast are conducted yearly.



Overlap between adjacent photographs is required for analytical stereo photogrammetry.

For most photographic missions, NGS deploys a Cessna Citation II Fanjet

aircraft equipped dual camera capability. This dual capability allows two types of photographs to be collected concurrently if conditions allow. Photography is acquired when weather conditions, sun angle, and, when applicable, water levels are optimal to ensure that photographs will be suitable for a variety of purposes using standard photogrammetric techniques.

Aerial photographs generally are available within four weeks after a mission is complete. As a matter of course, NGS also developed an index for the photographs that cross-references overlapping flight lines and geographical location. Reproduction services are available for photography in hard copy or digital form at scan rates from 25 to 250 microns (i.e.; 1,000 DPI to 100 DPI).

(top)

MAPFINDER

Environmental Sensitivity Index Maps

Abstract | Description | History | Present Status

Abstract

Environmental Sensitivity Index (ESI) maps are an integral component in oil-spill contingency planning and assessment. They serve as the first source of information in the event of an oil spill incident. ESI maps are a product of the Hazardous Materials Response Division of the Office of Response and Restoration (ORR).

Portion of an ESI map for San Diego, California. ESI maps contain three types of information: shoreline classification, human-use resources, and biological resources.

ESI maps contain three types of information: shoreline classification (specifically, sensitivity to oiling), human-use resources, and biological resources. This information is plotted on 7.5 minute USGS quadrangles. Collections of these maps, ESI atlases, have been prepared for most of the U.S. shoreline, including Alaska, Hawaii and the Great Lakes. Starting in the early 1990's, Geographic Information System (GIS) software has been used for ESI map compilation and production. Most atlases produced since that time are available in multiple GIS formats and Portable Document Format (PDF) as well as the standard hardcopy product.

Offerings of ESI maps are grouped into ESI atlases (e.g., Southern California, South Carolina, etc.). Atlas descriptive files are available and helpful in interpreting and using ESI maps. These files are available for direct download in PDF format for all atlases offered in NOS MapFinder.

Further information on oil spill response and other ORR programs

search

For More Information

FGDC Metadata (pdf, 112 kb)

Office of Response and Restoration ESI Mapping

About the Products

Hydrographic Survey

Estuarine Bathymetry

Coastal Photography

Environmental Sensitivity Index (ESI) Maps

Nautical Charts

Coastal Survey Maps

Water Level Stations

Geodetic Control Points

can be found on the ORR Home Page.

Description

Environmental Sensitivity Index mapping is a national NOAA program to characterize the coastal areas of the U.S. by providing a detailed and consistent source of information as a critical tool in oil spill response. Environmental Sensitivity Index (ESI) maps help reduce environmental consequences of spills and cleanup efforts by identifying shoreline sensitivity to oiling and important natural and human-use resources.

A boom surrounds a set of floating net pens at a salmon hatchery in Prince William Sound, Alaska, to protect the pens from oil spilled from the Exxon Valdez.

Oil spill planning and response remains the primary direct use of these maps, however they are finding ever widening use in such areas as coastal resource inventories and assessments, coastal planning, and recreational planning.

History

The primary objective of spill response in the United States, beyond the protection of human lives, is to reduce the environmental consequences of spills and the subsequent cleanup efforts. This is best achieved when ESI maps are used to identify the locations of sensitive resources before a spill occurs, so that protection priorities can be established and cleanup strategies designed in advance. For instance, sensitive wetlands are a high priority for protection, but when oiled, cleanup should be restricted to prevent additional damage from human activities. ESI shoreline classifications provide information necessary to aid in these decisions.

ESI maps include three types of information: shoreline sensitivity, biological resources, and human-use resources. Shoreline sensitivity classifies sections of shoreline into habitats according to geomorphological characteristics, sensitivity to spilled oil, natural persistence of oil, and ease of cleanup. Ranking is based on an understanding of the complete coastal environment

Sheltered tidal flats are classified as highly susceptible on the ESI shoreline ranking scale.

including the relationships between physical processes and substrate that produce specific shoreline types and predictable patterns in oil behavior and sediment transport.

Biological resources in ESI maps include oil-sensitive animals and plants, with information at the species level. Special attention is given to areas where concentrations of oil-sensitive species occur, such as breeding grounds, nesting habitats, and staging areas. Information is presented by specific life stages and months of occurrence.

Biological resources in ESI maps include oil-sensitive animals and plants, with information at the species level. Great egrets, shown above, are classified as wading birds most sensitive to oil-spills in rookery feeding and roosting areas.

ESI maps also identify human use resources that might be damaged by oil or response actions. These human-use resources include: recreational and shoreline access areas (e.g., parks and beaches), specially protected areas (e.g., wildlife reserves), water extraction sites (e.g., surface and ground water intakes), and historical and cultural sites (Some of this information is restricted to prevent vandalism.).

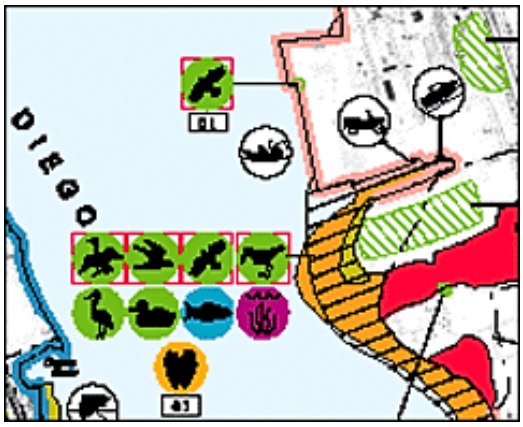
Many local organizations are developing information that builds on ESI content. The Environmental Sensitivity Index Guidelines publication was updated in 2002 to help such efforts. The guideline manual can be downloaded from the ORR website. Other ORR spill planning documents that use ESI classifications include the "Mechanical Protection Guidelines" and the "Shoreline Countermeasures series for temperate, tropical, Arctic, and freshwater environments."

Present Status

Since their inception in 1979, ESI atlases have been prepared for most of the U.S. shoreline, including the Great Lakes, Alaska, Hawaii, and the Trust Territories. Recent work has focused on extending the original methodology for open coastal areas to inland rivers, and smaller ponds and streams.

NOAA's ESI strategy emphasizes working with state and local partners to develop standardized ESI products. A typical ESI atlas

covers a state, such as South Carolina or a small region such as Delaware Bay. ESI maps are published as a collection of paper maps, bound as an atlas, and digitally on CD-ROM in multiple GIS formats and in Portable Document Format.



Shorelines are color-coded to indicate their sensitivity to oiling. Warm colors indicate areas of greater sensitivity, such as tidal flats and marshes, while cool colors denote less sensitive areas like sandy or rocky beaches.

PDF files allow users to easily view and print maps without the need for buying additional software. A free ESI viewer is also included on each ESI CD. The viewer allows users to view the digital data, make simple queries and print custom maps. Users with GIS software can take advantage of the ArcView 3.x project that is included. Here data base links are already established and the digital data has been symbolized using the standard ESI colors and fonts. Uncompressed ARC/INFO™ export files are also included as are the data base files in both a simplified and full relational format. All ESI CD's contain FGDC compliant metadata in multiple formats. For information on ordering ESI data on CD-ROM, see the ESI Order Form.

For additional information on ESI Mapping, visit the ESI story.

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MAPFINDER

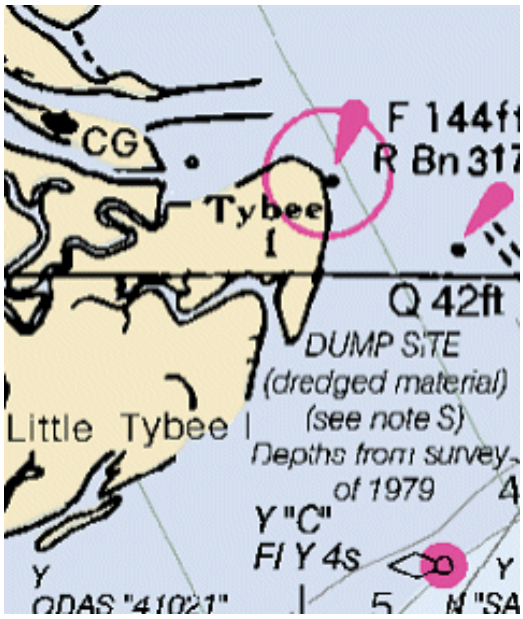
Nautical Charts

MapFinder no longer provides preview raster images of nautical charts. Click here for more information.

Abstract | Description | History | Present Status

Abstract

Nautical charts are fundamental navigational tools required for safe passage of waterborne commerce. They can also serve as base maps for resource management and shoreline development planning. Charts depict the location of the shoreline, minimum water depths, aids to navigation, hazards to navigation and much more. They are the primary product of the NOS Coast Survey.



Portion of a nautical chart. The overriding purpose of the nautical chart is to ensure safe and efficient navigation.

NOAA Nautical Charts are available in both paper and high resolution (254 dpi) raster form. The entire suite of more than 1,000 paper charts suitable for navigation, paper indexes, and related products are available from NOS and its worldwide network of Authorized Chart Agents. NOS MapFinder provides a spatial index of nautical charts for the U.S. and its territories.

Further information on nautical charts, lists of Authorized Chart Agents, and other programs and products on the Coast Survey can be found from the NOS Coast Survey Home Page.

Description

search

For More Information

Office of Coast Survey Navigational Charts

About the Products

- Hydrographic Survey
- Estuarine Bathymetry
- Coastal Photography
- Environmental Sensitivity Index (ESI) Maps
- Nautical Charts
- Coastal Survey Maps
- Water Level Stations
- Geodetic Control Points

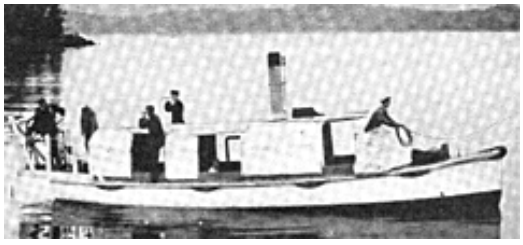
The nautical chart is the primary product of NOS' Coast Survey; as it has been since the first nautical chart of Newark Bay was published in 1839. The overriding purpose of the nautical chart is to ensure safe and efficient navigation. So important is the modern nautical chart that U.S. law requires vessels of commerce, piloted in U.S. coastal waters, to have the latest nautical chart and relevant updates for all areas in which they operate. A nautical chart is a "legal document" under the Federal Torte and Claims Act.

Early navigational map, circa 1650, used to explore the new world.

Nautical charts encompass the U.S. Exclusive Economic Zone, the shoreline seaward to 200 nautical miles. There are five types of charts: harbor charts, small-craft charts, coast charts, general charts and general sailing charts. Chart scales range from 1 to 10,000 to 1:10,000,000 with the vast majority between 1:40,000 and 1:200,000. Type and scale are determined by the importance of the area, the purpose for which the chart was designed, and the need to show clearly all dangers within the area. The average print cycle for a new edition of a nautical chart is 1-2 years.

Nautical charts are based primarily on data gathered from hydrographic surveys. Hydrographic surveys are conducted to locate and measure water depths, hazards to navigation, aids to navigation, shoreline changes, and prominent land features. Nautical charts are a compilation of the hydrographic data that represents both a map and a snapshot in time of the marine environment. Charts are constantly updated and revised. Over 35,000 new documents are received every year by the Coast Survey and evaluated on a "continual maintenance basis" for new hazards and dangers to safe navigation. New hazards are reported in a weekly publication called Notice to Mariners.

History



In 1807, Thomas Jefferson created the Survey of the Coast "...to cause a survey to be taken of coasts of the United States, in which shall be designated the islands and shoals and places of anchorage..." The first Superintendent of the new bureau was a Swiss mathematician and geodesist,

Ferdinand Hassler. His fundamental plan was to divide the operations into three great branches - the geodetic, the topographic, and the hydrographic.

An early photo, circa 1880, of a hydrographic survey. Hydrographic surveys are conducted to locate and measure water depths, hazards to navigation, aids to navigation, shoreline changes, and prominent land features.

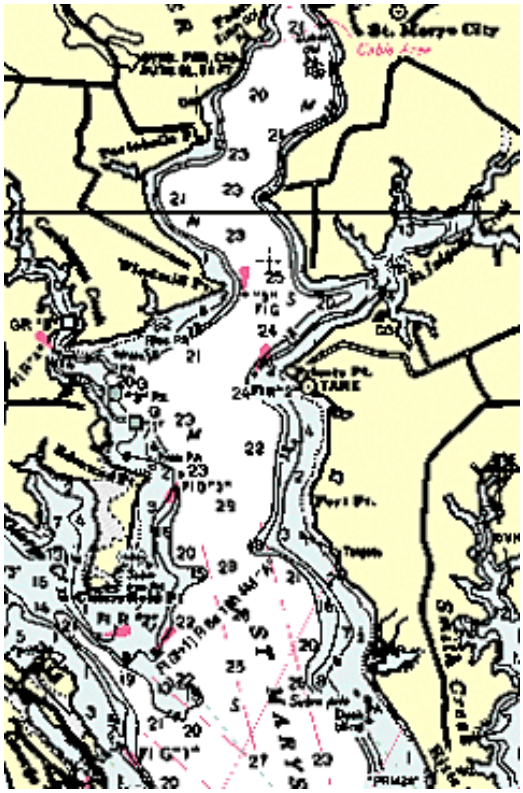
Portion of the first nautical chart of the Port of Boston, circa 1805. The earliest nautical charts were designed for wooden sailing ships, small shallow-draft ships dependent on wind and current for navigation.

The earliest nautical charts were designed for wooden sailing ships, small shallow-draft ships dependent on wind and current for navigation. The modern nautical chart evolved with the advent of the steamer in the early nineteenth century. The steamer, independent of wind, could follow any chosen course provided that it led through adequate depths. As ships continued to increase in size and draft, the focus of hydrographic surveys shifted from shoaler waters to deeper nearshore waters and channels. In 1839, the first nautical chart of Newark Bay was published using a stone engraving. In 1842, a copper-plate printing press was acquired and in 1844 a chart of New York Bay and Harbor was produced from a copper engraving. The copper engraving process showed much finer detail than the stone engraving.

Today, Coast Survey uses modern computer technology in the production and maintenance process to generate new editions of nautical charts. While satellite and computer technology has revolutionized the data collection and chart production process, it has not replaced the charting goals for completeness, accuracy and clarity of presentation, goals established by Hassler more than a

century and a half ago.

Present Status



Portion of a modern nautical chart of St. Mary's River, Maryland.

Coast Survey has the sole responsibility for the production and maintenance of almost 1,000 nautical charts. About 1.4 million charts are printed and sold each year. Nearly 40% of these are provided to the US military; the rest to commercial shipping, fisheries industries, and recreational boaters. A growing list of new users includes state and local environmental managers.

Coast Survey is committed to maintaining and assuring the distribution of the Nation's suite of nautical charts and nautical charting information in the appropriate formats to serve all classes of waterborne transportation. Soon, a new process of raster editing will be implemented to maintain digital raster charts of all 1,000 nautical charts so that a new edition of each chart can be produced as often as every week. The currency of these raster files will support emerging print technologies such as print on demand as well as CD-ROM technologies for distributing digital raster charts.

Coast Survey also distributes free of charge the Coastal Map series. These are designed to create an up-to-date, digital, and geo-referenced coastal map data layer, began as a way to provide the coastal stewardship community and general public with non-proprietary navigational chart images to be used as backdrops for Geographic Information Systems (GIS) derived products. Coastal maps are produced from NOS nautical charts for all near-shore geographic areas of the United States. Coastal Maps available here.

Charts of the Nation's 40 major ports are be maintained as digital vector data in the International exchange format S-57 to support Electronic Chart Display and Information Systems (ECDIS) so that critical navigational themes are current to within a week of the receipt of new information. These Electronic Navigational Charts (ENCs) are available here.

(top)

MAPFINDER

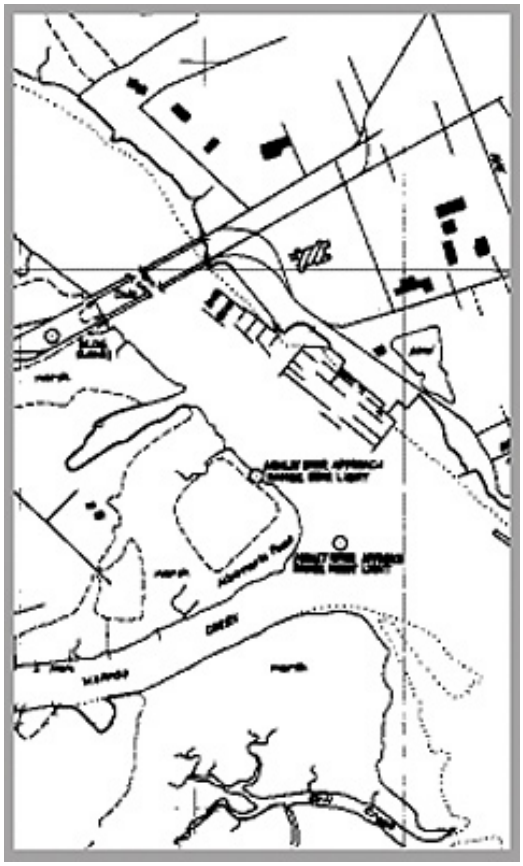
Coastal Survey Maps

Abstract | Description | History | Present Status

Abstract

Precise surveys of the Nation's coast and navigable near shore waters are the primary responsibility of the National Geodetic Survey's Remote Sensing Division. The surveys provide shoreline data for Nautical Chart production (See Nautical Chart products), and accurate geographical references needed for managing coastal resources.

The primary product of the surveys is the Coastal Survey Map, also known as the T-sheet. They accurately depict the shoreline, and shoreline features, such as rocks and tidal flats and range in scale from 1:5,000 to 1:40,000. There are about 2,000 current Coastal Survey Maps covering the shoreline of the United States and its territories.



Coastal surveys provide shoreline data for nautical chart production and accurate geographical references needed for managing coastal resources.

NOS MapFinder contains an index of 3,000 Coastal Survey Maps, and the corresponding raster GIF images (100 dpi) for the entire Atlantic, Pacific, and Gulf coasts, and portions of the Great Lakes, Alaska, Hawaii, and Puerto Rico.

Further information on coastal surveys and other programs of the National Geodetic Survey can be found on the NGS Home Page NGS Home Page.

search

For More Information

FGDC Metadata (pdf, 108 kb)

National Geodetic Survey

About the Products

- Hydrographic Survey
- Estuarine Bathymetry
- Coastal Photography
- Environmental Sensitivity Index (ESI) Maps
- Nautical Charts
- Coastal Survey Maps
- Water Level Stations
- Geodetic Control Points

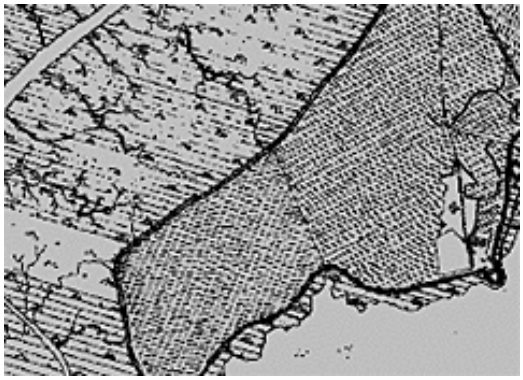
Description

Coastal survey maps are special use planimetric or topographic maps that precisely define the shoreline and alongshore natural and manmade features, such as rocks, bulkheads, jetties, piers, and ramps. These maps range in scale from 1:5,000 to 1:40,000. Carefully controlled for tide fluxes (standardized to Mean Low Water), these maps represent the most accurate delineation of shoreline in the Nation.

Coastal survey maps serve as the basic database of shoreline and topography used in the production of nautical charts. Historical data from these surveys are often used in litigation to determine property ownership, to enforce regulatory mandates, and to estimate rates of shoreline change. Additionally, these maps provide an accurate framework of geomorphic data for generating related products, such as submerged aquatic vegetation maps and shoreline movement maps used in managing the Nation's coastal resources.

Coastal Survey maps are used in many areas of coastal management including: 1) establishing marine boundary limits for offshore lease permits (Minerals Management Service), 2) determining baselines for setback limits for flood insurance (Federal Emergency Management Agency, and 3) managing coastal resources and analyzing coastal change (various local, state, and federal agencies).

History



Portion of a coastal survey map, circa 1850, San Francisco Bay area.

In 1807, Thomas Jefferson created the Survey of the Coast "...to cause a survey to be taken of coasts of the United States, in which shall be designated the islands and shoals and places of anchorage..." The first Superintendent of the new bureau was a Swiss mathematician and geodesist, Ferdinand Hassler. His fundamental plan was to divide the operations into three branches - the geodetic, the topographic, and the hydrographic.

The first shoreline survey was completed in 1834. Early vintage topographic and shoreline survey maps were made directly in the field and "on the beach" with the use of a plane table and alidade

In 1928 O.W. Swainson, then one of the nation's foremost authorities on topographic surveying, considered the plane table to be "one of the best instruments for topographic surveying, as with it the map is actually drawn in the field where and when the features

can be seen and where the amount of detail to be mapped, and the accuracy required can be judged to best advantage."

Using a plane table for creating an original coastal survey map.

In 1919 an investigation into the feasibility of aerial photography (or photogrammetry) to compile shoreline maps was started, and by 1927 the full potential of photogrammetry to complement the production of charts and maps was recognized. In 1930, Raymond Stanton Patton, then Director of the Coast Survey, stated: "the coast and geodetic survey is convinced that it is time for the airplane to take its proper place and be officially recognized in the bureau's mapping program." Subsequently, photogrammetric methods were consistently used in mapping and in providing surveys for the establishment of marine boundaries. In 1980, aerial photographs were made the sole source for coastal mapping. The maps provide the graphic representation and location of detail extracted from photographs, including delineation of the shoreline, alongshore structures, interior detail, and when applicable, the low water line. Although features were added and accuracy improved, developing the survey maps still required a painstaking process of manually rendering (or drawing) the features from aerial photographs onto a paper map.

In the 1990s technology advanced again with the introduction of digital processing. Now, digital stereo photogrammetry provides feature extraction from georeferenced aerial imagery. These digital files are incorporated directly into navigational charts. During this time, the paper coastal survey map, of the type offered in NOS MapFinder, was phased out.

Present Status

Since the early 1800s, over 14,000 coastal survey maps have been constructed. These maps provide coverage of about two-thirds of the Nation's coast. The other third of Nation's shore areas have never been surveyed with the majority of these areas being in Alaska. Most of the maps, even the earliest ones, have been preserved in their original paper form in a central archive. All 14,000

maps have been scanned into raster images. Work is proceeding to convert all of the raster images to vector data suitable for use in geographic information systems (GIS).

Until the 1990's, developing map lines from aerial photographs was still a painstaking manual process. Now, new technology allows for feature extraction from georeferenced aerial imagery.

(top)

MAPFINDER

Water Level Stations

Abstract | Description | History | Present Status

Abstract

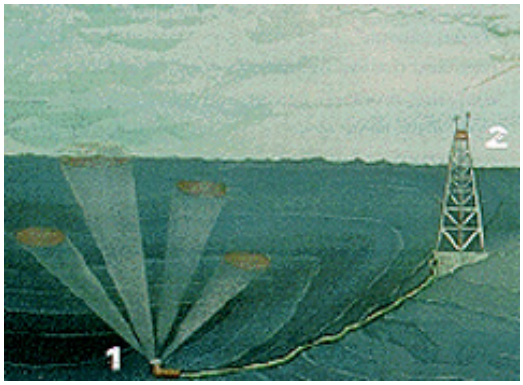


Diagram of a real-time water level station.

The National Water Level Observation Program Network (NWLON) provides the long-term water level records from which are derived the vertical reference datums used for surveying and mapping, dredging and coastal construction, water level regulation, marine boundary determination, tide prediction and for analysis of long-term water level variations and trends. It also supports tsunami and storm surge warning, tidal prediction, monitoring of climate and coastal processes, and tectonic research. The program is the responsibility of the Center for Operational Oceanographic Products and Services.

The foundation of the Program is the National Water Level Observation Network (NWLON). It is a network of 175 water level measurement stations distributed along U.S. coasts, the Great Lakes and connecting channels, and U.S. territories and possessions. These stations are in continuous operation and most transmit near real-time data via NOAA's family of Geostationary Operational Environmental Satellites (GOES).

The NOS MapFinder features water level station information for all of these coastal locations. This information includes geographic station location, descriptive location text, collected data types, and date of the earliest collected water level data. Further information on this Program can be found on the Center for Operational Oceanographic Products and Services web site.

Description

The National Water Level program, managed by the Center for

search

For More Information

FGDC Metadata (pdf, 120 kb)

Center for Operational Oceanographic Products and Services

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Hydrographic Survey

Estuarine Bathymetry

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Nautical Charts

Coastal Survey Maps

Water Level Stations

Geodetic Control Points

Operational Oceanographic Products and Services, has as its foundation the National Water Level Observation Network (NWLON). The network consists of 189 water level measurement stations located along U.S. coasts, the Great Lakes and connecting channels, and U.S. territories and possessions. It collects data on short and long term water level events. From this, the program determines vertical reference datums used for surveying and mapping, dredging and coastal construction, water level regulation, marine boundary determination, tide prediction, and analysis of long-term water level variations and trends.

Illustration of a wooden water level station used in 1897 at Fort Hamilton, New York. It is the earliest example of a real-time water level measuring device.

Vertical reference datums include: Mean Sea Level; Mean Lower Low Water, which legally determines the nation's shoreline; and Mean High Water, which determines the boundary between some state and private lands, and is the basis for defining the limits of the Nation's Exclusive Economic Zone and international High Seas.

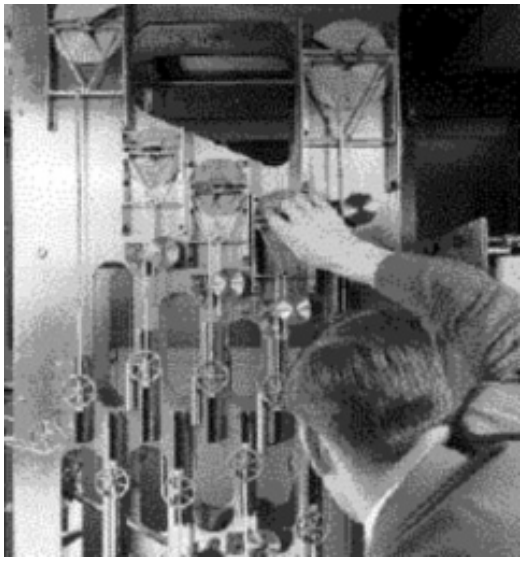
Tide predictions, for example, are used daily by all vessels sailing U. S. waters and by millions going fishing or planning all manners of seashore activities from beach walks to weddings. Every time you look up the tide predictions in your local newspaper you are using information derived directly from NWLON.

Besides its uses in determining U.S. coastal marine boundaries and on nautical charts, the Program uses the NWLON data to support tsunami and storm surge warnings, monitor climate and coastal processes, and tectonic research.

In the Great Lakes, water level data support water management and regulation, navigation and charting, river and harbor improvement, power generation, scientific studies and adjustment for vertical movement of the Earth's crust in the Great Lakes Basin.

The usefulness of water level prediction information is moving well beyond navigation. The Program's NWLON water level data are supporting society's growing environmental concerns with new customized products for regional and city managers. Engineering and construction firms use water level data to wisely plan future designs and operations. Law enforcement agencies occasionally seek tidal information to solve criminal and civil cases.

History



U.S. tide predicting machine used form 1912 to 1966. Operator is setting gears for tidal constituent's amplitude and phase.

In subsequent decades, the network of water level observation stations expanded and standard water level measurement equipment was adopted and installed. This consisted of a float (in a protective well) responding to the rise and fall of the water. The float was connected by a thin wire to a drum, chart paper and pen recorder. This equipment was maintained by a local person, such as the harbor master, who mailed chart records to the National office. In the last half of this century most water level stations were upgraded with modern electromechanical devices. These, however, still depended upon the use of a float in a protective well and the services of a human to monitor the whole operation.

U.S. tide predicting machine used from 1912 to 1966. The operator records times and heights of low and high waters.

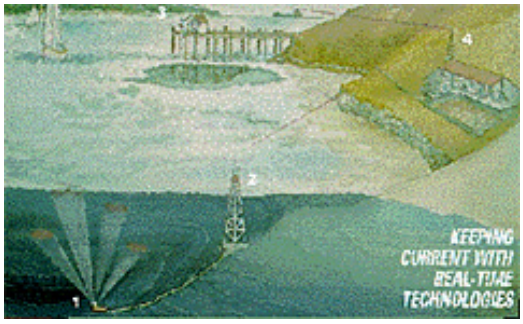
As this century begins, water level measurement technology has again advanced. NWLON is currently being upgraded from mechanical and electromechanical measurement equipment to a fully integrated electronic data collection, processing, and dissemination system, called the Next Generation Water Level Measurement System (NGWLMS). Today, nearly 100 percent of stations consist of a primary collection platform and a self-calibrating air-acoustic ranging sensor, eliminating the need for the float and the human monitor. Ancillary data, such as wind velocity, barometric pressure, air and water temperature, conductivity and relative humidity are also measured. Measurements are recorded every 6 minutes and transmitted every three hours via NOAA's suite of Geostationary Operational Environmental Satellites, to computers dedicated to immediate quality control, analysis and dissemination. All data are retrievable

from a relational database management system.

Personal computers, global telecommunication networks and partnerships with private companies are creating many new products and distribution pathways. New products run the gamut from pocket tide tables, office tide calendars, specialized products for sport fishermen and kayakers, sophisticated software packages for personal computers, and a growing industry of electronic nautical charts with real-time tidal data.

Present Status

Today, the National Water Level Program's National Water Level Observation Network (NWLON) consists of electronic instrumentation, data analysis and telemetry providing near real-time readings of water level. NWLON has 175 water level measurement stations distributed along U.S. coasts, in the Great Lakes and connecting channels, and in the U.S. territories and possessions.



Schematic diagram of a real-time water level station showing the relation of the instrument to transmitter and receiver .

These primary stations are in continuous operation and transmit data in near-real-time, i.e., every hour. In addition to these near-real-time records, archives also include historical data from over 5000 secondary and tertiary stations, i.e., those with records lengths from 18 years down to only a few weeks.

Currently, NWLON data are provided as standard water level products, such as, water level values at several data intervals (e.g., six-minute, hourly, etc.), daily highs and lows; daily, monthly and yearly means, and tidal datums (e.g., Mean Lower Low Water). NWLON data are also the foundation for NOAA's astronomical tide predictions which can be viewed for selected locations or ordered off-line.

(top)

MAPFINDER

Geodetic Control Points

Abstract | Description | History | Present Status

Abstract

The National Spatial Reference System (NSRS), maintained by the National Geodetic Survey (NGS), is a consistent National coordinate system that defines latitude, longitude, elevation, scale, gravity, and orientation throughout the Nation, as well as how these values change with time.

A Global Positioning System (GPS) receiver, the instrument primarily used today in precise positioning surveys. The observer is Phillip Johnson Tuwaletstiwa, NOAA Corps retired, operating a GPS receiver on a mesa in New Mexico. (Photo Credit: William Stone)

There are over 800,000 control survey points in the U. S. Approximately 6,500 of these form the highest accuracy core of the system. They include Federal Based Network (FBN), Cooperative Based Network (CBN), and Continuously Operating Reference Stations (CORS) sites covering the U.S. and its territories.

The NOS MapFinder contains a subset of information on the FBN, CBN, and CORS points. For more information, visit the National Geodetic Survey web site.

An ArcIMS site is also available for viewing and obtaining survey data from NGS.

Description

The National Spatial Reference System (NSRS), maintained by the National Geodetic Survey (NGS), is a consistent national coordinate system that precisely defines latitude, longitude, elevation, scale, gravity, and how these values have changed with time. This information is absolutely essential for ensuring the reliability of

search

For More Information

FGDC Metadata (pdf, 124 kb)

National Geodetic Survey

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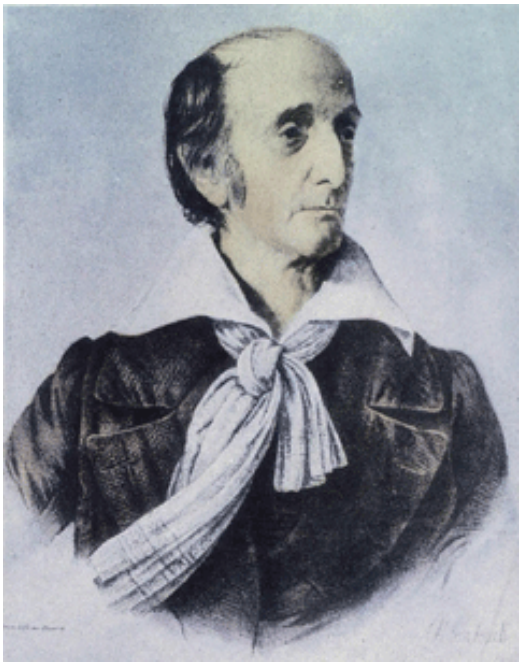
Water Level Stations

Geodetic Control Points

transportation, communication, and defense systems, boundary and property surveys, land record systems, mapping and charting, public utilities, coastal zone management, natural resource mapping, and a multitude of scientific and engineering applications.

History

At the beginning of the nineteenth century, the United States of America, enjoyed a vibrant economy which was dependent upon its fledgling maritime commerce industry. In 1807, Thomas Jefferson, created the Survey of the Coast "...to cause a survey to be taken of coasts of the United States, in which shall be designated the islands and shoals and places of anchorage..." The first Superintendent of the new bureau was a Swiss mathematician and geodesist, Ferdinand Hassler. Hassler realized that the surveying of the coast could only be accomplished by creating a reference system of scale and orientation that was defined by survey points of well known coordinates of latitude and longitude.



Ferdinand Hassler, the first Director of Coast Survey, was a Swiss mathematician and geodesist. He established geodetic surveying standards, procedures, and techniques required at that time to create a reference system for surveying the coasts.

Hassler established the geodetic surveying standards, procedures, and techniques required at that time to produce the reference system. Over time, geodetic surveying techniques evolved from "line of sight" observations to space oriented observations. "Line of sight" observations required that each survey point in the reference system be visible by at least one other survey point.

Hassler used geodetic theodolite instruments to determine orientation and tapes to measure the scale. Techniques to increase the distance in "line of sight" observations evolved over the next 150 years. Beginning in 1927, large "bilby" towers of over 130 feet were constructed over the survey points to increase the distance of visibility. In the 1950's, electronic distance measurement (EDM) instruments used lasers to precisely and quickly measure distances. Present geodetic surveying techniques use space oriented observations such as radio signals from distant quasars and signals from a configuration of artificial satellites known as the Global Positioning System (GPS).

Present Status

As the nation grew so did the size of the reference system that Hassler initially created. Presently there are over 800,000 control survey points throughout the U.S. that define the NSRS. One of the primary products of the system is a datasheet for each point which provides geodetic data such as coordinates of latitude, longitude, elevations, state plane coordinates, gravity data, and descriptive data on its physical location, characteristics, and history.

Beginning in 1927, large "Bilby" towers, named from their designer, Jasper Bilby, of over 130 feet were constructed over survey points to increase the distance of visibility for line of sight observations.

Present geodetic surveying techniques use space oriented observations such as radio signals from distant quasars and signals from a configuration of artificial satellites known as the Global Positioning System (GPS), shown above.

The advancement in surveying technology, particularly GPS, has increased the accuracy, reliability, and accessibility of the NSRS. "Line of sight" observations between survey points are no longer as critical, using today's technology, as they were during the days of Hassler. A grid of approximately 1,500 survey points with spacing of 100 KM, maintained by GPS surveying techniques can satisfy most of the needs of the NSRS and its surveying community.This grid of

survey points is a subset of the 800,000 points and creates the backbone of the NSRS, the Federal Based Network (FBN). In support of the FBN, there are approximately 700 Continuously Operating Reference Station (CORS) points, located primarily along the U.S. coastline and main waterways, that continuously receive positional information from GPS. Supplementing the FBN are approximately 4,900 Cooperative Based Network (CBN) points. These points, maintained by other organizations such as state and local governments, are included in the NSRS.

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